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An Old-Growth Definition for Seasonally Wet Oak-Hardwood Woodlands

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A Section of the Old-Growth Definition Series

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Preface

Old growth is widely acknowledged today as an essential part of managed forests, particularly on public lands. However, this concept is relatively new, evolving since the 1970's when a grassroots movement in the Pacific Northwest began in earnest to define old growth. In response to changes in public attitude, the U.S. Department of Agriculture, Forest Service, began reevaluating its policy regarding old-growth forests in the 1980's. Indeed, the ecological significance of old growth and its contribution to biodiversity were apparent. It was also evident that definitions were needed to adequately assess and manage the old-growth resource. However, definitions of old growth varied widely among scientists. To address this discrepancy and other old-growth issues, the National Old-Growth Task Group was formed in 1988. At the recommendation of this committee, old growth was officially recognized as a distinct resource by the Forest Service, greatly enhancing its status in forest management planning. The committee devised "The Generic Definition and Description of Old-Growth Forests" to serve as a basis for further work and to ensure uniformity among Forest Service Stations and Regions. Emphasis was placed on the quantification of old-growth attributes.

At the urging of the Chief of the Forest Service, all Forest Service Stations and Regions began developing old-growth definitions for specific forest types. Because the Southern and Eastern Regions share many forest communities (together they encompass the entire Eastern United States), their efforts were combined, and a cooperative agreement was established with The Nature Conservancy for technical support. The resulting project represents the first large-scale effort to define old growth for all forests in the Eastern United States. This project helped bring the old-growth issue to public attention in the East.

Definitions will first be developed for broad forest types and based mainly on published information and so must be viewed accordingly. Refinements will be made by the Forest Service as new information becomes available. This document represents 1 of 35 forest types for which old-growth definitions will be drafted.

In preparing individual old-growth definitions, authors followed the National Old-Growth Task Group guidelines, which differ from the standard General Technical Report format in two ways—the abstract (missing in this report) and the literature citations are listed in the Southern Journal of Applied Forestry style. Allowing these deviations will ensure consistency across organizational and geographic boundaries.

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Introduction

Southern bottomland hardwoods occur on approximately 32 million acres [13 million hectares (ha)] of forest land in river bottoms, minor stream bottoms, and swamps from Virginia to east Texas (McKnight and Johnson 1980). These ecosystems support a wide variety of tree species and communities (Meadows and Stanturf 1996), one of which is seasonally wet oak-hardwood woodlands. Past geologic events led to the formation of broad stream valleys in these areas because of the erodable, sedimentary geologic materials. Although the stream valleys of the Coastal Plain may be quite old, most of the floodplain sediments were formed in recent geologic times (Wharton et al. 1982).

An active river in an alluvial valley constantly cuts its banks on one side and deposits the soil downstream on the opposite side to form new land. Spring floods gradually raise the land by depositing coarser sediments near the riverbanks to build natural levees, and by dropping finer sediments farther back, to form low, broad, poorly drained "slackwater" areas. Complex but recognizable species associations characterize these sites. Cottonwood (*Populus deltoides* Bartr. ex Marsh.) and willow (*Salix nigra* Marsh.) are pioneer species on natural levees and are succeeded by riverfront species, then by oaks (*Quercus* spp.) and other species. A similar succession occurs in the backlands as sloughs, swamps, and oxbow lakes fill with sediment. Seasonally wet oak-hardwood woodlands can eventually occur on any of these sites (Putnam et al. 1960).

Seasonally Wet Oak-Hardwood Woodlands

Description of Forest Type Group

General Location—Seasonally wet oak-hardwood woodlands are scattered throughout the Eastern United States, ranging primarily from the Midwest south to eastern Oklahoma and Texas and eastward to Virginia. Commonly referred to as oak glades or flatwoods, these open woodlands develop best within the Ohio, Arkansas, and southern Mississippi River valleys.

Site Characteristics—These woodlands occur principally on river bottom lands and isolated depressions seasonally flooded for short periods. Soils are clayey; many have clay layers, deposited during river flooding, that may be mistaken for hardpans. Although soil drainage is poor, moisture conditions in these forests fluctuate dramatically. In summer, soil moisture deficits may occur if clay layers limit the rooting space available for trees and prevent the upward movement of water from lower wet zones.

Species—Principal species are pin oak (*Quercus palustris* Muenchh.), willow oak (*Q. phellos* L.), white oak (*Q. alba* L.), water oak (*Q. nigra* L.), diamondleaf oak (*Q. laurifolia* Michx.), and Nuttall oak (*Q. nuttallii* Palmer). Post oak (*Q. stellata* Wang.) predominates the Cross Timbers area of Texas and Oklahoma. Common associates include overcup oak (*Q. lyrata* Walt.), red maple (*Acer rubrum* L.), sweetgum (*Liquidambar styraciflua* L.), water hickory [*Carya aquatica* (Michx. f.) Nutt.], and waterlocust (*Gleditsia aquatica* Marsh.)

Site Disturbance—If, in presettlement times, surfaces dried out during summer, low-intensity fires could have occurred. Although such burns would probably have been confined primarily to the litter layer, they would have helped maintain the open conditions of these woodlands by checking woody regeneration. Large oaks are fire tolerant and were largely unaffected by surface burns, whereas fire-sensitive species such as red maple, American elm (*Ulmus americana* L.), and green ash (*Fraxinus pennsylvanica* Marsh.) were adversely affected. Even though fires have been largely controlled over the last century, the open condition of these woodlands is usually maintained due to the unusual hydrologic constraints of the sites.

Associated Society of American Foresters Forest Cover Types

One or more principal species in the seasonally wet oak-hardwood woodlands are associate species in the following Society of American Foresters forest cover types:

40—post oak-blackjack oak (in part)
53—white oak (in part)
65—pin oak-sweetgum (in part)
88—willow oak-water oak-diamondleaf (laurel) oak (in part)

Physiographic Provinces (after Fenneman 1938)

- Coastal Plain (all sections except Floridian)
- Appalachian plateaus (unglaciated Allegheny Plateau section)
- Interior low plateaus (all sections)
- Central lowland (till plains, dissected till plains, and Osage Plains sections)
- Ozark plateaus (all sections)
- Ouachita (all sections)

Old-Growth Conditions

Living Tree Component

Old-growth, seasonally wet oak-hardwood woodlands is usually a mixture of tree species, chiefly oaks, of many sizes and ages. The canopy is typically multilayered (table 1), and tree age varies accordingly, from young reproduction (Winters et al. 1938, Arkansas Department of Planning 1974) occurring in openings created by dead trees or windthrow, to mature trees 150 years old or more.[1] Large canopy trees may reach 110 feet [33.5 meters (m)] in height (see footnote 1).

Winters et al. (1938) describe a typical old-growth stand. The woodland contained 174 trees per acre (70.5 trees per ha) ranging in size from 2 to 40 inches (5 to 102 centimeters [cm]) in diameter at breast height (d.b.h.). Fifty-nine percent of the trees were 2 to 4 inches (5 to 10 cm) in d.b.h., 24 percent were 6 to 12 inches (15 to 30 cm) in d.b.h., 8.5 percent were 14 to 18 inches (36 to 46 cm) in d.b.h., 6 percent were 20 to 28 inches (51 to 71 cm) in d.b.h., 2 percent were 30 to 38 inches (76 to 97 cm) in d.b.h., and less than 1 percent were 40 inches (102 cm) or larger in d.b.h. Sixty-two percent of the trees were classified as good (potentially usable sawtimber). Thirty-four percent were sound culls, that is, trees with no rot, but having poorly formed, excessively limby boles, or other defects. Three percent were classified as rotten culls; trees that would eventually become snags or fall. Winters et al. (1938) defined rotten cull trees as (1) sawlog-size trees containing at least half their board-foot volume in logs culled because of rot and (2) smaller trees containing at least half their cubic foot volume in rotten material. These trees represented about 3 percent of all diameter classes or 5.6 trees per acre (13.8 trees per ha).

Dead Tree Component

Meadows (see footnote 1) found an average of 16 to 20 dead trees per acre (40 to 49 trees per ha), representing 12 to 14 percent of the total number of trees. Most of these were Nuttall oak, sweetgum, and elm.

Woody debris is difficult to quantify for this forest type group. Because of prevailing high temperature and relative humidity, decay organisms are very active, resulting in rapid decomposition (3 to 4 years) of downed woody debris. Consequently, woody debris is scarce and composed almost exclusively of recently fallen tree limbs and boles. No literature defined or quantified the amount of downed wood in this forest type.

Understory Characteristics

Understory vegetation is commonly a diverse mixture of young trees, vines, and shrubs that range from sparse to very thick (Putnam et al. 1960, Arkansas Department of Planning 1974). Small woody species, such as planertree (*Planera aquatica* J.F. Gmelin), buttonbush (*Cephalanthus occidentalis* L.), wild grape (*Vitis* spp.), pepper-vine [*Ampelopsis arborea* (L.) Koehne], trumpet-creeper [*Campsis radicans* (L.) Seeman], poison-ivy [*Toxicodendron radicans* (L.) Kuntze], and honeysuckle (*Lonicera* spp.) usually originate ahead of tree reproduction and, at times, may form virtually impenetrable thickets (Putnam et al. 1960, Arkansas Department of Planning 1974). Tree regeneration is thus largely excluded. Small trees are common in the understory and include American hornbeam (*Carpinus caroliniana* Walt.), eastern hophornbeam [*Ostyra virginiana* (Miller) K. Koch], flowering dogwood (*Cornus florida* L.), and hawthorn (*Crataegus* spp.).

Young seedlings of canopy-tree species develop either from seed or sprouts and are typically most abundant beneath canopy gaps. During unfavorable periods (e.g., intense competition/shade), tree seedlings frequently die back and resprout. Where a thick mat of underbrush is present, it may take 20 years for tree seedlings to grow through this layer. Seedling and sapling development is most rapid in openings, which, in old growth, can be 300 feet (91.4 m) in diameter (Arkansas Department of Planning 1974). Chief obstacles to old-growth regeneration include shade, flooding, and fire. Together these factors largely control seedling and sapling composition.

[1] Meadows, J.S. February 1990. Study on long-term timber growth and quality following an improvement cutting in an uneven-aged stand vs. clearcutting to produce an even-aged stand. Unpublished report. On file with: Southern Research Station, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, MS 38776.

Table 1 (English units)—Standardized table of old-growth attributes for seasonally wet oak-hardwood woodlands

Quantifiable attribute	Value		Number of stands[a]	References
	Range	Mean		
Stand density (no./acre) —trees ≥4 in d.b.h.	40-215	125.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Stand basal area (ft^2 /acre) —trees ≥4 in d.b.h.	44.3-214.1	90.9	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Age of large trees (yrs)[c] —all species	80-150	85.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Number of 4-in. size classes —4 in d.b.h.	9	9.0	1	Society of American Foresters 1980
D.b.h. (or maximum d.b.h.) of largest trees (in) —all species	45	45.0	1	Meadows, unpublished data[b] Society of American Foresters 1980
Standing snags (no./acre) —snags ≥4 in d.b.h.	0-75	20.0	2	Meadows, unpublished data[b] Society of American Foresters 1980
Downed logs (ft^3/acre)[d]	–	–	–	
Decadent trees (no./acre)[e] —≥4 in d.b.h.	0-60	44.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Number of canopy layers	Multilayered	--[d]	5	Arkansas Dept. of Planning 1974 Meadows, unpublished data[b] Putnam and Bull 1932 Putnam et al. 1960 Society of American Foresters 1980
Percent canopy in gaps[d]	–	–	–	
Other features[d]	–	–	–	

[a] Number of stands may not equal the number of citations.
[b] Meadows, J.S. February 1990. Study on long-term timber growth and quality following an improvement cutting in an uneven-aged stand vs. clearcutting to produce an even-aged stand. Unpublished report. On file with: Southern Research Station, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, MS 38776.
[c] Includes dominant and codominant trees that make up the upper canopy.
[d] Data not available.
[e] Includes deformed, bole-scarred, spike-topped, and wind-damaged trees.

Table 1 (metric units)—Standardized table of old-growth attributes for seasonally wet oak-hardwood woodlands

Quantifiable attribute	Value		Number of stands[a]	References
	Range	Mean		
Stand density (no./ha) —trees ≥10-cm d.b.h.	100-506	308.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Stand basal area (m^2/ha) —trees ≥10-cm d.b.h.	110-528	225.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Age of large trees (yrs)[c] —all species	80-150	85.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Number of 10-cm size classes —starting at 10-cm d.b.h.	9	9.0	1	Society of American Foresters 1980
D.b.h. (or maximum d.b.h.) of largest trees (cm) —all species	114	114.0	1	Meadows, unpublished data[b] Society of American Foresters 1980
Standing snags (no./ha) —snags ≥10-cm d.b.h.	0-185	49.0	1	Meadows, unpublished data[b] Society of American Foresters 1980
Downed logs (m^3/ha)[d]	–	–	–	
Decadent trees (no./ha)[e] —trees ≥10-cm d.b.h.	0-152	107.0	3	Meadows, unpublished data[b] Putnam and Bull 1932 Society of American Foresters 1980
Number of canopy layers	Multilayered	--[d]	5	Arkansas Dept. of Planning 1974 Meadows, unpublished data[b] Putnam and Bull 1932 Putnam et al. 1960 Society of American Foresters 1980
Percent canopy in gaps[d]	–	–	–	
Other features[d]	–	–	–	

[a] Number of stands may not equal the number of citations.
[b] Meadows, J.S. February 1990. Study on long-term timber growth and quality following an improvement cutting in an uneven-aged stand vs. clearcutting to produce an even-aged stand. Unpublished report. On file with: Southern Research Station, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, MS 38776.
[c] Includes dominant and codominant trees that make up the upper canopy.
[d] Data not available.
[e] Includes deformed, bole-scarred, spike-topped, and wind-damaged trees.

Soils and Microtopography

These woodlands occur principally along streams where there is seasonal flooding for short periods. Coarse sediment deposited near the bank of the river during floods forms narrow ridges or natural levees (Putnam et al. 1960). Farther from the river, where flood waters eddy and slow, finer sediments are deposited, forming low, broad areas of poorly drained, slack water clay soils. Seasonally wet oak-hardwood woodlands may occur on any of these sites (i.e., low ridges, flats, and sloughs). Because of their lowland situation and unique soil properties (e.g., clay hardpans), soil moisture in these woodlands tends to fluctuate dramatically throughout the year, from excessively moist during high water to moisture deficits during the growing season. Soil pH varies from approximately 5.0 to 8.0, depending on age, topography, and parent material. The organic mat (0 horizon) is usually several inches thick, and organic-matter content in the A horizon can be as high as 5 percent.

Even though this definition is for seasonally wet oak-hardwood woodlands, we must keep in mind this oak type is transitory. The soils that support this group would normally be occupied first by the pioneer species (cottonwood and willow), followed by the riverfront type and the oaks. Over most of its range, the seasonally wet oak-hardwood woodland would ultimately be replaced by more tolerant types and finally beech (*Fagus* spp.) -magnolia (*Magnolia* spp.) as the climax if succession were allowed to proceed naturally. Only good forest management can maintain the seasonally wet oak-hardwood woodland type.

Other Important Features

The abundance of undergrowth usually makes these woodlands good habitat for deer. However, the number of deer may be limited by flooding, especially in the absence of high, wooded ground (Arkansas Department of Planning 1974). Many bird and rodent species usually inhabit these woodlands, especially during the old-growth stage. Aquatic animals (e.g., fishes, amphibians) can also be numerous during wet periods.

Forest Dynamics and Succession

Only small, scattered remnants of old-growth, seasonally wet, oak-hardwood woodlands remain. Because of the long history of logging and other human disturbances, most present-day woodlands differ from their presettlement counterparts. However, based on regeneration trends, the natural forces that formed past woodlands are still working today, so recovery from human disturbance seems likely for many stands (Arkansas Department of Planning 1974).

A typical succession for these woodlands is as follows: within 15 years of a stand-initiating disturbance, a full canopy is produced by trees and large shrubs. Over the next 30 to 50 years, the woodland will mature and old-growth processes will begin (e.g., canopy-tree deaths, gap-phase regeneration). Within 100 to 150 years, mature trees will begin to die, and, as younger trees replace them, a "multiple-aged" forest will develop (Arkansas Department of Planning 1974). This process could continue for another 100 years or until the next stand-altering disturbance.

Winters et al. (1938) reported that settlement in the North Louisiana Delta began early in the 19th century. By 1850, cotton was being produced on much of the high, riverfront land where water transportation was easily available. The pattern of land disturbance they described in that area is probably typical of most of the area where seasonally flooded oak-hardwood woodlands were found.

During the Civil War and the subsequent reconstruction period, agriculture was interrupted and thousands of acres of abandoned farmland reverted to forests. Shortly after 1900, large timber companies began to acquire land, and lumber production became an important industry. World War I brought another agricultural boom, and cutover timberlands were converted to farming again. Land clearing for farming continued until the depression of the 1930's. Much of the remaining virgin forest was also cutover by the late 1930's to the early 1940's. By the late 1930's, only about half the original forests remained. Clearing continued at a rapid pace through the late 1970's, by which time only about 20 percent of the original forest in the Lower Mississippi River valley was left.

Presently, much of the cleared land is in crop production and will probably remain so. Some acreage that is marginal to submarginal for agriculture may be converted to forest under government programs, such as the Conservation Reserve Program and the Wetlands Restoration Project. However, these tracts will make up only a small portion of the total land area and will take a long time to develop into old-growth forests.

Representative Old-Growth Stands

Some representative stands exist on the 2,700-acre (1093.5-ha) Delta Experimental Forest, Washington County, Stoneville, MS, and the 58,000-acre (23,490.0-ha) Delta National Forest, Sharkey County, Rolling Fork, MS. Another unique site is located on the Edgefield Ranger District of the Sumter National Forest. A non-alluvial swamp forest, dominated by large willow oak, is located at this site. Soils are a montmorillonite clay (Nelson 1986). There are probably other representative stands unknown to the authors. Areas where other representative old-growth stands may appear include Coochie Brake, Winn Parish, LA; Big Oak Tree Natural Area, Big Oak Tree State Park, MO; Deep Slough, St. Charles County, MO; and Quercus Flatwoods Natural Area, George White State Forest Nursery, MO.

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An interim definition of old-growth, seasonally wet, oak-hardwood woodlands is presented to assist in management of these communities until comprehensive definitions based on research can be formulated. The basic criteria for identifying old-growth, seasonally wet, oak-hardwood woodland communities in the South are also presented.

Keywords: Bottomland hardwoods, flatwoods, oak glades, old growth, old-growth stands, *Quercus* spp., South.

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